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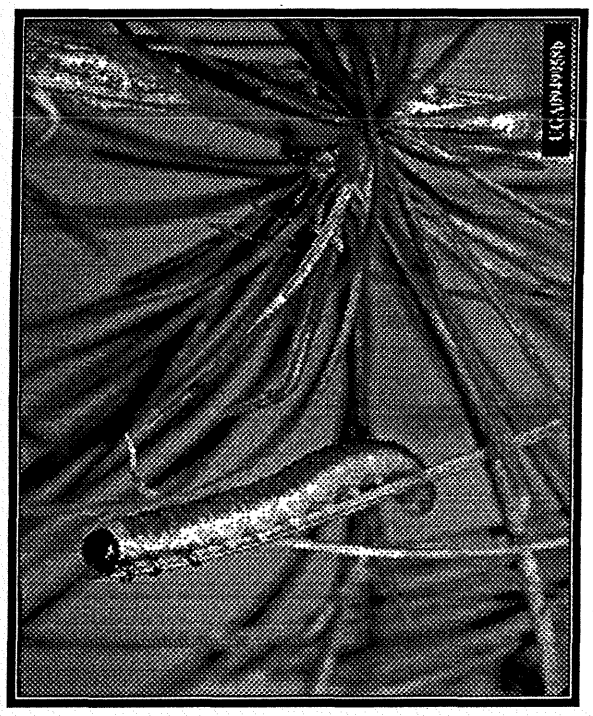
Evaluation of Larch Sawfly Damage and Spruce Blowdown:

Innoko National Wildlife Refuge; August, 2000



Biological Evaluation R10-TP-88

December 2000

USDA Forest Service
Alaska Region
State & Private Forestry
Forest Health Protection
3301 C Street, Ste. 522
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Prepared by:

Ed Holsten, Entomologist
Forest Health Protection
Region 10, Alaska

Approved by:

Jerry Boughton, Program Manager
Forest Health Protection
Region 10, Alaska

Paul W. Forward
Deputy Regional Forester for S&PF
Region 10, Alaska

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INTRODUCTION

The State of Alaska encompasses more than 365 million acres of which approximately 130 million acres are classified as forest land (USDA Forest Service 1992). The majority of the forested lands (115 million acres) occur in interior Alaska. The vegetation types of interior Alaska are a mosaic of vegetation that is related to slope and aspect, past fire history, and the presence or absence or permafrost. Most forest stands are a mixture of two or more tree species including white and black spruce, tamarack (= eastern larch), aspen, birch, and balsam popular (Viereck and Little 1972).

Forest insects and diseases also play an important role in boreal forests by altering successional pathways, increasing fuel loading from heavy bark beetle caused tree mortality, increasing defect of commercial species, delaying rotation ages of commercial species, altering wildlife habitat, etc. Some of the more damaging forest insects associated with Alaska's boreal forests are: Larch Beetle (*Dendroctonus simplex*), Engraver Beetles (*Ips* spp.), Spear-Marked Black Moth (*Rheumaptera hastata*), Large Aspen Tortrix (*Choristoneura conflictana*), Larch Budmoth (*Zeiraphera* sp.), Spruce Budworm (*C. fumiferana*), and the Larch Sawfly (*Pristiphora erichsonii*) (Holsten and others 1985).

For the last seven years, larch sawfly populations have reached epidemic conditions throughout the range of tamarack in interior Alaska. For a more detailed description of the larch sawfly and silvics of tamarack refer to Appendices 1 and 2 at the end of this report. The larch sawfly was first reported in 1880 in North America near Boston, Mass. By 1965 it could be found from Maine to Washington and in the tamarack outposts of Alaska (Drooz 1971). The sawfly is most destructive on eastern tamarack (*Larix laricina*), less so on western larch (*L. occidentalis*) or subalpine larch (*L. lyallii*). Exotic larches, such as Siberian larch (*L. sibirica*) are also attacked.

Prior to 1993, there was little or no larch sawfly activity detected in interior Alaska. In 1993, more than 12,000 acres of tamarack were heavily defoliated near Fairbanks and Nenana. By 1996, larch sawfly populations exploded and more than 600,000 acres of tamarack were heavily defoliated from Fairbanks to McGrath between the Tanana and Kuskokwim Rivers. In 1999, larch sawfly was accidently introduced into the Mat-Su Valley and the Anchorage Bowl where it has been detected feeding on ornamental Siberian larch. The preferred host, *L. laricina*, does not occur south of the Alaska Range. By 2000, larch sawfly populations were collapsing. Extensive areas of tamarack "mortality" can be seen over the entire range of tamarack in Alaska.

In August 2000, Anchorage Forest Health Protection (FHP) staff conducted an evaluation of tamarack mortality and white spruce blowdown within the Innoko

National Wildlife Refuge (INWR) headquartered in McGrath. The Refuge Manager and Research Biologists have been concerned with the extensive "mortality" of tamarack and lack of natural regeneration of tamarack within the Refuge as well as a concern of increasing spruce bark beetle (*D. rufipennis*) activity as a result of an wide-scale wind event that occurred in the Fall/Winter of 1998-99.

METHODS

During the hour plane trip to the INWR field camp along the Innoko River, approximately southwest of McGrath, it was observed that almost every tamarack appeared heavily defoliated, if not dead. Scattered white spruce wind throw was observed during the trip.

In order to determine the "health" of tamarack, 10 ½ x 1 chain (1/20 acre) transects were randomly established throughout forest types that contained tamarack as a predominate tree species. Diameter of tree species, whether they were alive or dead, the presence of larch beetle activity, and the percent of sawfly defoliation of tamarack were noted. In addition, two tamarack sites that were easily accessible from the field camp were selected. Fifty tamarack were randomly selected in each site and numbered with aluminum tags. Diameter at breast height (dbh), whether the tamarack were alive or dead, the incidence of larch beetle activity and the percent of live crown remaining were noted. These two plots will be re-visited next year in order to determine tamarack growth rates, amount of natural regeneration, and amount of tamarack mortality resulting from larch sawfly defoliation.

Approximately 15 large diameter (> 16") wind thrown spruce were evaluated for the presence of spruce and engraver beetle population build-up.

RESULTS AND DISCUSSSION

Survey Flights: FHP personnel conduct annual forest insect and disease aerial detection surveys. A final report concerning Forest Insect and Disease conditions will be finalized and distributed by January 2001. Preliminary results noted extensive and heavy tamarack defoliation/"mortality" east of the Yukon River from Bull Frog Island south to Fox Point Island. Survey flights also followed the Innoko River from Holikachuk to its confluence with the Yukon River. Scattered tamarack defoliation/"mortality" was detected as well as several hundred acres of engraver beetle (*Ips* sp.) infested white spruce stands. Areas of heaviest *Ips* beetle caused tree mortality are located approximately 18 miles northwest of Fox Hills. Another are of heavy *Ips* beetle activity was located approximately 10 miles north of Aniak.

1/20 acre Transects: The forested areas surveyed averaged approximately 1300 tamarack/acre of which 21% were dead (Table 1). Cause of mortality could not be determined precisely, but the majority of tree mortality is believed to have been caused by heavy sawfly defoliation for five or more successive years. Only 1% of the tamarack was under attack by the larch beetle. Seventy percent of the live tamarack was 70% defoliated. The majority of the defoliation occurred in the upper and lower tree crowns. The live foliage was extremely stunted and chlorotic. It was not determined whether this foliage was foliage "of-the-year" or regrowth after sawfly defoliation. Few sawfly larvae were observed. This may be due to: (1) population collapse, or (2) larvae had completed development and were in the pupal stage in the duff/litter layer. Little or no tamarack regeneration was noted in the surveyed areas. There did not appear to be a viable seed crop in 2000 and tamarack sites appear to be marginal for natural regeneration (See Appendix 2). In addition to the tamarack, there were approximately 460 black spruce per acre of which 17% were dead; cause(s) of mortality unknown.

Table 1. Stand conditions and defoliation levels from 10 1/20 acre transects, Innoko River, Alaska.

Av # Live Larch /acre	Av # Dead[1] Larch /acre	Av. dbh[2] ~~Dead~~ Live Larch	Av. dbh Dead Larch	Av # Live Spruce /acre	Av # Dead Spruce /acre	Av. dbh Live Spruce	Av. dbh Dead Spruce	% of Larch Defol.	Av. % Defoliat.
966	262 (14)	3.1	4.5	384	76	3.3	3.1	71	~70

[1] Number in ( ) is the number of trees showing larch beetle activity, [2] dbh in inches.

Permanent Plots: Two areas were selected near the Innoko River Field Camp for monitoring of tamarack growth rates, mortality, and regeneration. Fifty tamarack were randomly selected in each area. Selected trees were numbered with aluminum tags. Plot 1 is located to the right of camp, on the same side of the lake, approximately ¼ mile away. The plot is located ~ 50 yards from shore and is oriented 40^0 magnetic. Plot 2 is located across the lake from camp and to the left and is also located ~ 50 yards from shore and is oriented 70^0 magnetic. For a description of the tagged trees, see Appendix 3.

Spruce Blowdown: Approximately ten large diameter (>16") windthrown spruce were evaluated for the presence of spruce or engraver beetle activity. Few of the examined spruce had signs of spruce beetle activity. Spruce beetle brood development was low. These trees pose little threat for increasing spruce beetle populations to damaging levels. They will not be suitable for spruce beetle habitat next year due to "souring" of the phloem layer. Engraver (*Ips* sp;

probably *perturbatus*) was very apparent in most of the evaluated blowdown. Brood production appeared high. It was also observed that many of the spruce stands are slowly "unraveling" as a result of the 1998/99 wind event. Consequently, there will be a continued supply of breeding habitat for *Ips* possibly leading to an outbreak. *Ips* outbreaks, unlike spruce beetle outbreaks, which can last for more than five years, are usually of short (3 yrs.) duration. FHP aerial detection surveys will continue to monitor *Ips* caused tree mortality within the INWR.

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[1] Alaska forest insect and disease survey information and general forest health information can be obtained from **<http://www.fs.fed.us/r10/spf/fhpr10.htm>**

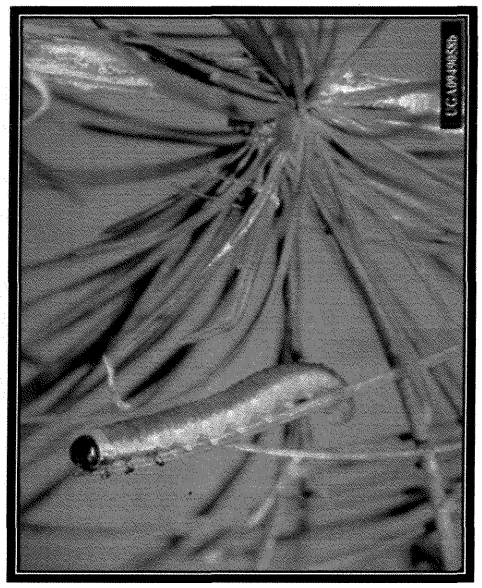
Appendix 1

LARCH SAWFLY
HYMENOPTERA: TENTHREDINIDAE
Pristiphora erichsonii (Hartig)

HOSTS – Eastern larch (Tamarack) and ornamental Siberian larch

DISTRIBUTION – Interior Alaska; north of the Alaska Range; accidently introduced into south-central Alaska

IDENTIFICATION – Adult females are 10 mm long with black antennae and bodies. The abdomen has a broad orange band and tapers sharply towards the rear. Males have yellowish antennae, orange abdominal band, but the abdomen is cylindrical and rounded at the rear. Eggs are translucent and about 1.5 mm long. Late instars have shiny black heads with bodies that are gray green along the back and whitish beneath. Tough, papery cocoons are brown in color and approximately 13 mm long.



INJURY – Sawfly larvae eat the needles on the older parts of twigs. Heavy defoliation may completely strip the tree and cause a significant loss in growth. Larch growing on poor sites that have been defoliated for consecutive years may die. Larch needles are naturally shed in the fall, and larches withstand defoliation better than "evergreen" conifers.

REMARKS – Detectable larch sawfly defoliation had not been observed in Alaska for more than 30 years until the mid-1990's. Large outbreaks (>150,000 hectares) developed in interior Alaska and have lasted for more than five consecutive years. Scattered larch mortality became apparent especially on

poorer sites. Adults emerge in early to late spring. Less than 2 percent are males. Reproduction is parthenogenic. Each female lays 20-200 eggs; depositing them under the bark of the current terminal twigs. Recently emerged larvae move back to the foliage on older twigs and generally feed in groups. Mature larvae drop to the ground, enter the duff, and spin cocoons where they spend the winter.

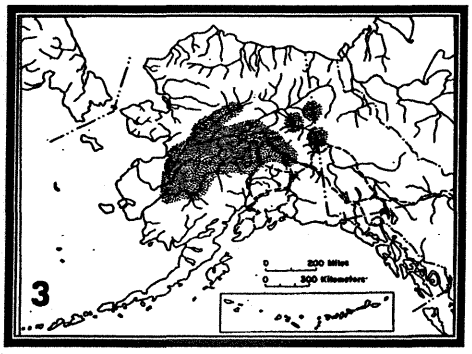
Larch sawflies were accidently introduced into south-central Alaska (Mat-Su Valley and Anchorage Bowl) in 1999 on Siberian larch, a common and highly desirable ornamental. This introduction could prove costly for home-owners.

Appendix 2

TAMARACK
PINACEAE
Larix laricina (Du Roi) K. Koch

DESCRIPTION: Tamarack (also known as eastern larch) is a small to medium sized deciduous tree averaging 4-10" in diameter and 30-60 ft. in height. The leaves (needles), shedding in fall, are located in clusters of 12-20 on short stout spur twigs. Needles are slender and flexible, 3-angled, blue-green turning yellow before falling in early autumn. The bark is dark gray, smooth and thin. Tamarack is the only Alaska conifer shedding its needles in winter.

RANGE: Tamarack has one of the widest ranges of all North American conifers. Its primary range extends from Newfoundland west along the northern limit of trees into the northern Yukon Territory. It extends southward into New England. A major disjunct area of tamarack is found in interior Alaska, in the Yukon and Kuskokwim River basins between the Brooks Range on the north and the Alaska Range on the south.



Distribution of Tamarack in Alaska (from Vierek and Little 1972)

SOIL & TOPOGRAPHY: Tamarack can tolerate a wide range of soil conditions but grows most commonly on wet to moist organic soils. Tamarack is more abundant on muskegs along with black spruce (*Picea mariana*) than trees characteristic of surrounding uplands as they can withstand high soil moisture, high acidity, and low soil temperature. In Alaska, tamarack also grows well on upland sites having wind-deposited loess soils.

SEED PRODUCTION, GERMINATION, AND DISSEMINATION: Vigorous, open-grown trees 50 to 150 years old produce the best cone crops. Tamarack bears good seed crops at intervals of 3-6 years. Seed dispersal takes place from September to early spring. Empty cones remain on the trees from 2 to 5 years.

Although the seeds are small (3 mm long), few fall at a distance greater than twice the tree height. More than half the seeds that fall are destroyed by rodents. As a result of this, plus losses by fungi and bacteria, only 4-5% of the seed may germinate. The best seed-bed is warm, moist mineral or organic soil with no brush but a light cover of grass or other herbaceous vegetation. Because they are small, tamarack seedlings are easily killed, primarily by damping-off, during the first 6 to 8 weeks after germination. Tamarack site index is negatively correlated to the amount of standing water.

COMPETITION: With abundant light, tamarack is one of the fastest growing conifers on uplands in the boreal forest. Growth rates are significantly reduced with crown closure. Tamarack is very intolerant of shade and is a pioneer species. It does not become established in its own shade. Consequently, the more tolerant black spruce eventually succeeds tamarack on poor (bog) sites.

COMMERCIAL USES: The principal commercial use of tamarack in the United States is for making pulp products. It is also commonly used for posts, mine timbers, poles due to its rot resistance. In Alaska young tamarack stems are used for dogsled runners, boat ribs, and fish traps.

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Appendix 3
Innoko River Tamarack Plots

Plot 1:

Tree[1]	dbh[2]	"dead"[3]	<30[4]	31-50	51-75	>75	Tree	dbh	"dead"	<30	31-50	51-75	>75
1	8			x			2	4		X			
3	2		x				4	5			x		
5	5			x			6	7			x		
7	6				x		8	2		x			
9	3	x					10	4			x		
11	5			x			12	5			x		
13	2		x				14	6			x		
15	7			x			16	4		x			
17	4		x				18	3	x				
19	5			x			20	4		x			
21	3		x				22	3		x			
23	8		x				24	5		x			
25	4		x				26	3		x			
27	4		x				28	3	x				
29	5		x				30	4		x			
31	6		x				32	6			x		
33	2	x					34	2		x			
35	4		x				36	4	x				
37	5			x			38	4			x		
39	2	x					40	2		x			
41	8			x			42	8				x	
43	2		x				44	4			x		
45	2		x				46	7		x			
47	2		x				48	2		x			
49	<2		x				50	<2		x			

[1]= larch beetle activity; [2] = diameter in inches; [3] = appears dead; [4] = % live crown left

Plot 2:

Tree	dbh	"dead"	<30	31-50	51-75	>75	Tree	dbh	"dead"	<30	31-50	51-75	>75
1	10				x		2	9		x			
3	8			x			4	3		x			
5	8		x				6	3		x			
7	9			x			8	<2	x				
9	4		x				10	2	x				
11	6			x			12	9			x		
13	6		x				14	10		x			
15	9			x			16	8		x			
17	6		x				18	4	x				
19	6			x			20	5		x			
21	6		x				22	6		x			
23	6		x				24	12		x			
25	3	x					26	8		x			
27	7		x				28	4	x				
29	3		x				30	9			x		
31	4		x				32	2		x			
33	8		x				34	5			x		
35	7			x			36	6			x		
37	3		x				38	6		x			
39	8		x				40	7			x		
41	5		x				42	5		x			
43	12		x				44	5		x			
45	7		x				46	2		x			
47	9X	x					48	5			x		
49	4	x					50	8		x			